temperature-calibrated with the target value of temperature set at 895° C. via the thickness of the oxide film. In this manner, the case where a provisional target value of temperature used in the temperature measuring step differs from a latent actual target value temperature is also included in the technical scope of the present invention.

Also, in the embodiment described above, two process temperatures of 900° C. and 905° C. are set, and the film-thickness/temperature coefficient is actually obtained. However, it is possible to use the film-thickness/temperature coefficient, which is obtained by experiments in advance.

The growth rate of a film thickness is represented by formula (1) given below, and formula (2) given below can be obtained by partially differentiating formula (1) with respect to temperature T:

$$V=A\cdot\exp(-E/KT) \quad (1)$$

$$\{\partial V/\partial T\}/V=(E/K\cdot T2)*100[\%/^\circ C] \quad (2)$$

where V denotes the growing rate of the film thickness, K denotes the Boltzmann constant, T denotes absolute temperature, and E denotes activation energy.

Since formula (2) represents the film-thickness/temperature coefficient, the value of the film-thickness/temperature coefficient can be obtained by substituting in formula (2) the activation energy, the temperature, and the film thickness, which are obtained by experiments.

Where the film-thickness/temperature coefficient is used, it is possible to allow the set value of temperature for the temperature control unit **5** to be easily brought close to and onto the target value. However, it is also possible to repeat the processing without using the film-thickness/temperature coefficient such that the set value of temperature is adjusted to achieve a uniform film thickness by trial and error. Also, in the embodiment described above, a general model is described on the respective sides of the manufacturer and the user of the heat treating apparatus. However, it is possible for all the steps described above to be performed on the side of the user.

Further, the heat treatment is not limited to the oxidizing process. It is possible to apply the technical idea of the present invention to an arbitrary film forming process such as formation of a nitride film by using ammonia and dichlorosilane. Also, where the temperature of the temperature measurement wafer is measured in the temperature measuring step, it is possible to use a radiation thermometer or the like in place of the temperature measuring element **12** such as a thermocouple. Further, the method of the present invention for calibrating the temperature can be applied to not only batch type heat treating apparatuses but also to single-substrate type heat treating apparatuses in which wafers or the like is subjected to a heat treatment one by one.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

What is claimed is:

1. A method of temperature-calibrating a second heat treating apparatus based on a heat treatment result obtained by a first heat treating apparatus for reference, the first heat treating apparatus comprising a first process chamber, a first heating unit for heating an inside of the first process chamber, and a first controller for setting a temperature of the first heating unit, the second heat treating apparatus comprising a second process chamber, a second heating unit for heating an inside of the second process chamber, and a second controller for setting a temperature of the second heating unit, the first and second process chambers being substantially equal to each other in construction and the first and second heating units being substantially equal to each other in construction, the method comprising:

a temperature measuring step of heating a measurement substrate for measuring temperature at a selected position within the first process chamber by the first heating unit, and obtaining a first set value of temperature of the first controller for converging a measured temperature of the measurement substrate to a target value of temperature;

a heat treating step on a primary side of forming a first thin film on a first substrate by heating the first substrate at the selected position within the first process chamber by the first heating unit while setting the first controller at the first set value of temperature, the first thin film being formed under a selected process pressure and selected process gas conditions that are selected such that a growth rate of the first thin film is changed as a function of temperature;

a heat treating step on a secondary side of forming a second thin film equal in material to the first thin film on a second substrate substantially equal in size and material to the first substrate under the selected process pressure and selected process gas conditions by heating the second substrate at a position, corresponding to the selected position, within the second process chamber by the second heating unit; and

a calibrating step of obtaining a second set value of temperature of the second controller at the time when a thickness of the first thin film and a thickness of the second thin film are made equal to each other, and temperature-calibrating the second heat treating apparatus based on an assumption that the target value of temperature is obtained at the position, corresponding to the selected position, within the second process chamber at a time when a set temperature of the second controller is the second set value of temperature.

2. The method according to claim **1**, wherein the heat treating step on the secondary side is performed a plurality of times respectively to a plurality of second substrates to obtain the second set value of temperature, in which the second controller is set at different set values of temperature among the plural second substrates.

3. The method according to claim **2**, wherein, when the second heat treating step is performed the plurality of times respectively to the plurality of second substrates, the second controller is set at the different set values of temperature based on adjustment data representing a relationship between an amount of change in a thickness of the first thin film and an amount of change in temperature in forming the first thin film.

4. The method according to claim **3**, wherein the adjustment data includes a film-thickness/temperature coefficient.

5. The method according to claim **3**, wherein the adjustment data is formed by setting a plurality of target values of temperature as the target value of temperature, and each of the temperature measuring step and the heat treating step on the primary side are carried out for each of the plurality of target values of temperature.

6. The method according to claim **3**, wherein the adjustment data is formed by applying a heat treating step equivalent to the heat treating step on the primary side to another

first substrate, except that the first controller is set at a set value of temperature deviant from the first set value of temperature.

7. The method according to claim 3, wherein the adjustment data is formed by experiments prior to the temperature measuring step.

8. The method according to claim 1, wherein the measurement substrate includes a temperature measuring element mounted thereon.

9. The method according to claim 1, wherein the first and second substrates are substantially equal in size and material to a substrate to be subjected to a heat treatment in the second heat treating apparatus.

10. The method according to claim 1, wherein the measurement substrate comprises a substrate substantially equal in size and material to the first and second substrates.

11. A method of temperature-calibrating a second vertical heat treating apparatus based on a heat treatment result obtained by a first vertical heat treating apparatus for reference, the second vertical heat treating apparatus being configured to apply a heat treatment to a plurality of target substrates, which are substantially equal to each other in the contour size, altogether, the first heat treating apparatus comprising a first process chamber, a first heating unit having a plurality of first heaters arranged to heat zones differing from each other in height level inside the first process chamber, and a plurality of first controllers for setting temperatures of the first heaters, the second heat treating apparatus comprising a second process chamber, a second heating unit having a plurality of second heaters arranged to heat zones differing from each other in height level inside the second process chamber, and a plurality of second controllers for setting temperatures of the second heaters, the first and second process chambers being substantially equal to each other in construction and the first and second heating units being substantially equal to each other in construction, the method comprising:

a temperature measuring step of heating a plurality of measurement substrates for measuring temperature at selected positions within the zones of the first process chamber by the first heaters, and obtaining a first set value of temperature of each first controller for converging a measured temperature of each measurement substrate to a target value of temperature;

a heat treating step on a primary side of forming a first thin film on each of a plurality of first substrates by heating the first substrates at the respective selected positions within the first process chamber by the first heaters while setting each of the first controllers at the first set value of temperature, the first thin film being formed under a selected process pressure and selected process gas conditions that are selected such that a growth rate of the first thin film is changed as a function of temperature;

a heat treating step on a secondary side of forming a second thin film equal in material to the first thin film on each of a plurality of second substrates substantially equal in size and material to the first substrates under the selected process pressure and selected process gas conditions by heating the second substrates at positions, corresponding to the selected positions, within the second process chamber by the second heaters; and

a calibrating step of obtaining a second set value of temperature of each of the second controllers at the time when a thickness of the first thin film and a thickness of the second thin film are made equal to each other, and temperature-calibrating the second heat treating apparatus based on an assumption that the target value of temperature is obtained at the positions, corresponding to the selected positions, within the second process chamber at a time when a set temperature of each of the second controllers is the second set value of temperature.

12. The method according to claim 11, wherein the heat treating step on the secondary side is performed a plurality of times respectively to a plurality of groups of second substrates to obtain the second set value of temperature, in which the second controller is set at different set values of temperature among the plurality of groups.

13. The method according to claim 12, wherein, when the second heat treating step is applied to the plurality of groups, each of the second controllers is set at the different set values of temperature based on adjustment data representing a relationship between an amount of change in a thickness of the first thin film and an amount of change in temperature in forming the first thin film.

14. The method according to claim 13, wherein the adjustment data includes a film-thickness/temperature coefficient.

15. The method according to claim 13, wherein the adjustment data is formed by setting a plurality of target values of temperature as the target value of temperature, and each of the temperature measuring step and the heat treating step on the primary side are carried out for each of the plurality of target values of temperature.

16. The method according to claim 13, wherein the adjustment data is formed by applying a heat treating step equivalent to the heat treating step on the primary side to another plurality of first substrates, except that each of the first controllers is set at a set value of temperature deviant from the first set value of temperature.

17. The method according to claim 13, wherein the adjustment data is formed by experiments prior to the temperature measuring step.

18. The method according to claim 11, wherein each of the measurement substrates includes a temperature measuring element mounted thereon.

19. The method according to claim 11, wherein the first and second substrates are substantially equal in size and material to the target substrates.

20. The method according to claim 11, wherein each of the measurement substrates comprises a substrate substantially equal in size and material to the first and second substrates.

* * * * *